IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
PCT RECEIVING OFFICE

Applicant	:	General Hospital Corporation
International Application No.	:	PCT/US2004/029148
International Filing Date	:	8 September 2004
Title of Invention :		METHOD AND APPARATUS FOR PERFORMING OPTICAL IMAGING USING FREQUENCY-DOMAIN INTERFEROMETRY

AMENDMENT UNDER ARTICLE 34
AND REPLY TO PCT WRITTEN OPINION

VIA FACSIMILE +49 89 2399 - 4465
AND EXPRESS MAIL (EXPRESS MAIL LABEL NO. EV 619311828 US)
European Patent Office (acting as ISA)
D-80298 Munich
Germany

Attention: Schmidt C., Authorized Officer
RO/EP

I hereby certify that this paper is being faxed and then deposited with the United States Postal Service as Express Mail No. EV619311828US in an envelope addressed to: European Patent Office, D-80298 Munich, Germany, on

August 23, 2005
Date of Deposit

Gary Abelev
Attorney Name

40,479
U.S. PTO Registration No

Signature

August 23, 2005
Date of Signature

Dear Sir/Madam:

In accordance with the PCT Rules, Applicant hereby submits this reply to the PCT Written Opinion (the "Opinion") mailed March 22, 2005 in the above-referenced international application.

IN THE CLAIMS:

Pursuant to PCT Article 34, submitted herein are replacement/supplemental pages 50-63 of the above-identified PCT application, which correspond to claims identified below.

In particular, claims 3, 19, 21, 45 and 62 were amended, and new independent claims 94 and 95 were added above, as follows:

3. (Currently Amended) The apparatus according to claim 1, further comprising at least one third arrangement for shifting the frequency of at least one of the at least one first electro-magnetic radiation, the at least one second electromagnetic radiation, the at least one third electro-magnetic radiation ~~and~~ or the at least one ~~third~~ fourth electro-magnetic radiation.

19. (Currently Amended) The apparatus according to claim 1, further comprising an arrangement emitting a particular radiation which is provided to the at least one first arrangement when the at least one first arrangement provides the first and second electro-magnetic radiations based on the particular radiation, wherein at least one of the first and second electro-magnetic radiations ~~which~~ has a spectrum whose mean frequency changes substantially continuously over time at a tuning speed that is greater than 100 Tera Hertz per millisecond.

21. (Currently Amended) An apparatus comprising:

at least one first arrangement providing at least one first electro-magnetic radiation to a sample and at least one second electro-magnetic radiation to a reference, wherein at least one of the first and second electro-magnetic radiations has a spectrum

which changes over time, the spectrum containing multiple ~~frequencies at a particular time~~ differing longitudinal modes; and

at least one second arrangement detecting an interference between at least one third radiation associated with the at least one first radiation and at least one fourth radiation associated with the at least one second radiation.

45. (Currently Amended) A method comprising the steps of:

providing at least one first electro-magnetic radiation to a sample and at least one second electro-magnetic radiation to a reference, wherein at least one of the first and second electro-magnetic radiation has a spectrum which changes over time, the spectrum containing multiple ~~frequencies at a particular time~~ differing longitudinal modes; and

detecting an interference between at least one third radiation associated with the at least one first radiation and at least one fourth radiation associated with the at least one second radiation.

62. (Currently Amended) The apparatus according to claim 61~~46~~, wherein the catheter is rotated at a speed higher than 30 revolutions per second.

94. (New) An apparatus comprising:

at least one first arrangement providing at least one first electro-magnetic radiation to a sample and at least one second electro-magnetic radiation to a reference, wherein at least one of the first and second electro-magnetic radiations has a spectrum whose mean frequency changes substantially continuously at a repetition rate of approximately 15.7 KHertz; and

at least one second arrangement detecting an interference between at least one third radiation associated with the at least one first radiation and at least one fourth radiation associated with the at least one second radiation.

95. (New) A method comprising the steps of:

providing at least one first electro-magnetic radiation to a sample and at least one second electro-magnetic radiation to a reference, wherein at least one of the first and second electro-magnetic radiations has a spectrum whose mean frequency changes substantially continuously over time at a repetition rate of approximately 15.7 KHertz; and

detecting an interference between at least one third radiation associated with the at least one first radiation and at least one fourth radiation associated with the at least one second radiation.

STATUS OF THE CLAIMS:

Claims 3, 19, 21, 45 and 62 were amended, and new independent claims 94 and 95 were added above, as follows which are attached herewith.

Claims 1, 2, 4-18, 20, 22-44, 46-61, 63-78 and 80-93 remain unchanged in this international application.

Accordingly, claims 1-95 are currently under consideration in the above-identified international application.

REMARKS

I. INTRODUCTION

Applicant gratefully acknowledges the international Examiner's statement in the Opinion that all previously pending claims 1-93 have industrial applicability under PCT Article 33(4), and that claims 7-14, 16, 19 (in part), 34-43, 46-70, 71-79 (in part) and 81-93 meet the novelty requirements under PCT Article 33(2).

However, the international Examiner believes that claims 19 and 71-79 do not meet the requirement of PCT Article 6 as allegedly not being clearly defined. In addition, the international Examiner asserts that claims 1-6, 15, 18, 20-33, 45, 45 and 80 lack novelty under PCT Article 33(2), and that claims 1-18, 19 (in part), 20-70, 71-79 (in part) and 80-93 lack inventive step under PCT Article 33(2).

Claims 3, 19, 21, 45 and 62 have been amended, and new independent claims 94 and 95 have been added above. For the reasons set forth below and due to the clarifying amendments to claims 21 and 45, Applicant respectfully submits that the now-pending claims 1-95 are neither anticipated nor rendered obvious by the references relied on by the international Examiner in the Opinion. Accordingly, Applicant requests the international Examiner to withdraw the statements concerning the lack of novelty in

claims 1-6, 15, 18, 20-33, 45, 45 and 80 and lack of inventive step in claims 1-18, 19 (in part), 20-70, 71-79 (in part) and 80-93, and further confirm that the now-pending claims 1-95 fully comply with PCT Articles 33(2)-(4). In addition, Applicant requests the international Examiner to confirm that claims 19 and 71-79 are clearly defined in compliance with PCT Article 6.

II. CLAIMS 19 AND 71-79 COMPLY WITH PCT ARTICLE 6

In the Opinion, the international Examiner contends that the subject matter recited in claims 19 and 71-79 is not clearly defined, and thus fails to meet the requirements as set forth in PCT Article 6. In particular, the international Examiner believes that the claims only define the subject matter in terms of the result to be achieved, without providing the technical features necessary for achieving the underlying result. (See Opinion, sheet 1, Section III; 1st paragraph). Therefore, this claim was interpreted by the international Examiner as comprising the features of the embodiment with the grating and rotating polygon as shown in, e.g., Figure 6 of the above-identified international application, and examined as such matter. Applicant respectfully disagrees, and traverses this objection.

Claim 19 recites "an arrangement emitting the first and second electro-magnetic radiations at least one of which has a spectrum whose mean frequency changes substantially continuously over time at a tuning speed that is greater than 100 Tera Hertz per millisecond." In addition, claims 71 and 79 recite that "at least one of the first and second electro-magnetic radiations has a spectrum whose mean frequency changes substantially continuously over time at a tuning speed that is greater than or equal to 100 Tera Hertz per millisecond." Clearly, the technical characteristic of the arrangement which emits such electromagnetic radiation is included in this claim. This characteristic

is the use of the spectrum of the electromagnetic radiation which has a mean frequency that changes substantially continuously over time at a tuning speed that **is greater than 100 Tera Hertz per millisecond**. The result of this claim is not such novel technical characteristic, and instead the emission of the electro-magnetic radiation.

Accordingly, Applicant respectfully asserts that claims 19, claims 71 and 79 and the claims which depend therefrom are clearly defined by setting forth the technical features of the claimed arrangement. There is absolutely no reason or necessity to include the features in the claims which have not been explicitly recited therein. Therefore, the features not explicitly recited in claims 19 and 71-79 should not and cannot be incorporated therein.

Therefore, it is respectfully requested that claims 19 and 71-79 are confirmed as fully complying with PCT Article 6.

II. CLAIMS 1-93 ARE NOT ANTICIPATED/RENDERED OBVIOUS BY REFERENCES RELIED ON BY EXAMINER

A. CLAIMS 1-20 AND 80

In the Opinion, the international Examiner alleged that claims 1-20 and 80 are anticipated by International Publication No. WO 98/35203 ("D1").

i. Claims 1, 2, 4-8, 10-17 and 20

Regarding claims 1-2, 4-8, 10-17 and 20, Applicant respectfully submits that D1 does not anticipate independent claims 1 and 20, and claims 2, 4-8 and 10-17 which depend from independent claim 1.

D1 describes an interferemetric imaging system in which light is reflected from a sample arm and a reference arm, and directed to a Faraday circulator 204. (See D1, p. 16, lns. 19-23) Then, D1 states that the magnitude of the reference reflector is

made as small as possible *but sufficient to achieve shot-noise limited operation in the receiver*. (See *id*., p. 16, ln. 23 to p. 17, ln. 5; *emphasis added*).

However, in clear contrast to Applicant's invention, D1 nowhere discloses that at least one electro-magnetic radiation is provided to ***a non-reflective reference***, as explicitly recited in independent claims 1 and 20. In fact, D1 clearly states that the reference must be reflective, even though its reflection should be as small as possible. Thus, not only D1 fails to disclose that the electro-magnetic radiation is provided to a non-reflective reference, D1 clearly teaches away from Applicant's invention recited in independent claims 1 and 20 by *requiring a reflector* to be used as a reference. Indeed, the system of D1 *will not work* without having a reflector for a reference. No other reference relied on by the international Examiner in the Opinion cures such deficiency of D1.

Claims 2, 4-8 and 10-17 depend from independent claim 1. Accordingly, the arguments provided herein above with reference to independent claims 1 and 20 are repeated herein for claims 2, 4-8 and 10-17.

ii. Claims 3 and 80

Regarding claim 3, this claim depends from independent claim 1. Accordingly, the argument set forth above for claim 1 is restated herein in its entirety. In addition, Applicant respectfully submits that D1 also does not disclose "**at least one third arrangement for *shifting the frequency* of at least one of the at least one first electro-magnetic radiation, the at least one second electromagnetic radiation, the at least one third electro-magnetic radiation or the at least one fourth electro-magnetic radiation**," as explicitly recited in claim 3. With respect to independent claim 80, D1 also does not disclose "**at least one second arrangement adapted for shifting the**

frequency of the at least one first electro-magnetic radiation [provided to the sample] and the at least one second electromagnetic radiation [provided to the reference]," as explicitly recited in this claim.

Indeed, D1 does not even mention much less describe any arrangement which is capable of shifting the frequency of the radiations that are associated with the radiation *provided to the sample and/or reference, or shifting the resultant interference radiation.* It is further asserted that D2 does not cure at least this deficiency of D1. In the Opinion, the international Examiner pointed to element 320 shown in Figure 6 of D1 as allegedly disclosing these claimed features. However, the frequency shifter 320 of D1 referred to by the international Examiner is provided in the source that generates the initial electromagnetic radiation initially being emitted, but in no way describes the frequency shifts of the electro-magnetic radiation being provided to the sample, the reference, and/or the interfered radiation exiting the interferometric arrangement. No other reference relied on by the international Examiner in the Opinion cures such deficiency of D1.

iii. Claim 9

Regarding claim 9, this claim depends from independent claim 1 and claim 3. Accordingly, the arguments set forth above for claim 1 and 3 are restated herein in their entireties. In addition, claim 9 recites the arrangement that detects the interference between the electro-magnetic radiations is a "bandpass filter having **a center frequency that is approximately the same as a magnitude of the frequency shift by the frequency shifting arrangement.**" Even though the use of the bandpass filter is known in the art, neither D1 nor any other publication relied on by the international Examiner (e.g., D3) teaches, suggests or discloses that such bandpass filter has *a center frequency*

that is approximately the same as a magnitude of the frequency shift by the frequency shifting arrangement. The international Examiner does not point to any section of D1 or any section of other references in support of the allegation that such subject matter is disclosed, taught or suggested therein.

iv. Claim 18

Regarding claim 18, this claim depends from independent claim 1. Accordingly, the argument set forth above for claim 1 is restated herein in its entirety. In addition, claim 44 recites "**at least one third arrangement for tracking the phase difference**" between electro-magnetic radiation The international Examiner does not point to any section of D1 or D2 in support of the allegation that such subject matter is disclosed, taught or suggested therein. Indeed, none of the references relied on by the international Examiner even mention, much less teach, suggest or disclose that *the third arrangement is capable of tracking phase difference between electro-magnetic radiations.*

v. Claim 19

Regarding claim 19, this claim depends from independent claim 1. Accordingly, the argument set forth above for claim 1 is restated herein in its entirety. In addition, claim 19 recites that "**at least one of the first and/or second electro-magnetic radiations has a spectrum whose mean frequency changes substantially continuously over time at *a tuning speed that is greater than 100 Tera Hertz per millisecond.***" The international Examiner does not point to any section of D1 or any section of other references in support of the allegation that such subject matter is disclosed, taught or suggested therein. Indeed, none of the references relied on by the international Examiner even mention, much less teach, suggest or disclose that a spectrum (of the electro-

magnetic radiation) has a mean frequency which changes substantially continuously over time at *a tuning speed that is greater than 100 Tera Hertz per millisecond.*

vi. Summary

Accordingly, Applicant respectfully requests a confirmation that claims 1-20 and 80 fully comply with PCT Articles 33(2) and 33(3).

B. CLAIMS 21-45

In the Opinion, the international Examiner alleged that claims 21-45 are rendered obvious by D1, taken alone or in combination with International Publication No. WO 97/32182 ("D2")

i. Claims 21, 22, 24-34, 36, 37, 39-43 and 45

Amended independent claims 21 and 45 recite that "**at least one of the first and second electro-magnetic radiations [provided to the sample and the reference, respectively] has a spectrum which changes over time, the spectrum containing multiple differing longitudinal modes.**" It appears that in the Opinion, the international Examiner agrees that D1 fails to disclose at least this recitation, and states that broadband sources are generally well known in connection with an OCT instrument by pointing to page 2, line 15 of D2. However, while D2 describes the spectrum of the electro-magnetic radiation, such spectrum in D2 is always constant, and <u>does not change over time</u>. In addition, D2 fails to cure another deficiency of D1, as not teaching or suggesting that such spectrum contains *multiple differening longitudinal modes*, as recited in independent claims 21 and 45. In fact, D2 only utilizes <u>a single longitudinal mode for the spectrum of the electro-magnetic radiation</u>.

Claims 22, 24-34, 36, 37 and 39-43 depend from amended independent claim 21. Accordingly, the arguments provided herein above with reference to amended independent claims 21 and 45 are repeated herein for claims 22, 24-34, 36, 37 and 39-43.

ii. Claim 23

Regarding claim 23, this claim depends from independent claim 21. Accordingly, the argument set forth above for claim 21 is restated herein in its entirety. In addition, claim 23 includes similar recitations as provided in claim 3, and thus the arguments provided above for claim 3 are also repeated herein.

iii. Claim 35

Regarding claim 35, this claim depends from independent claim 21 and claim 23. Accordingly, the arguments set forth above for claims 21 and 23 are restated herein in their entireties. In addition, claim 35 includes similar recitations as provided in claim 9, and thus the arguments provided above for claim 9 are also repeated herein.

iv. Claim 38

Regarding claim 38, this claim depends from independent claim 21. Accordingly, the arguments set forth above for claim 21 is restated herein in its entirety. In addition, claim 38 recites that "**the catheter is rotated as a speed higher than 30 revolutions per second.**" The international Examiner does not point to any section of D1 or D2 in support of the allegation that such subject matter is disclosed, taught or suggested therein. Indeed, none of the references relied on by the international Examiner even mention, much less teach, suggest or disclose that the catheter is rotated as *a speed higher than 30 revolutions per second.*

v. Claim 44

Regarding claim 44, this claim depends from independent claim 21. Accordingly, the argument set forth above for claim 21 is restated herein in its entirety. In addition, claim 44 includes similar recitations as provided in claim 18, and thus the arguments provided above for claim 18 are also repeated herein.

vi. Summary

Accordingly, Applicant respectfully requests a confirmation that claims 21-45 fully comply with PCT Articles 33(2) and 33(3).

C. CLAIMS 46-70

In the Opinion, the international Examiner alleged that claims 46-70 are rendered obvious by D1, taken alone or in combination with International Publication No. WO 92/19930 ("D3")

i. Claims 46, 47, 49-51, 53-58, 60, 61, 63-67, 69 and 70

As an initial matter, Applicant respectfully submits that neither D1 nor D3, taken alone or in combination, teach, suggest or disclose that **a frequency of radiation provided by the first arrangement (which provides electro-magnetic radiation to the sample and the reference) varies over time**, as explicitly recited in independent claims 46 and 69. Indeed, D1 nowhere mentions, much less teaches, suggests or discloses that the frequencies of the electro-magnetic radiations being provided to the sample and the reference vary over time. The international Examiner also does not allege that D3 cures any such deficiency, and also does not point to any section of other references to teach or suggest such subject matter.

In addition, Applicant respectfully asserts that D3 is not combinable with D1 in a manner contemplated by the Examiner to teach or suggest the detection of the interfometric signals having polarizations that are different from one another, as also recited in independent claims 46 and 69. This is at least because the use of the system described in D3 would not work in conjunction with the systems described in D1. In fact, the alleged combination of teachings of D1 and D3 would produce a system that would not be operable. Further, even if D1 can be combined with D3 in a manner contemplated by the international Examiner, the resultant combination still fails to teach, suggest or disclose the generation of the first and second electro-magnetic radiations (provided to the sample and the reference), at least one of which has a frequency of radiation provided by the first arrangement varies over time, ***and*** the detection of the interferometric signals having polarizations that are different from one another, as recited in independent claims 46 and 69.

Claims 47, 49-51, 53-58, 60, 61 and 63-67 depend from independent claim 46, and claim 70 depends from independent claim 69. Accordingly, the arguments provided herein above with reference to independent claims 46 and 69 are repeated herein for claims 47, 49-51, 53-58, 60, 61, 63-67 and 70.

ii. Claim 48

Regarding claim 48, this claim depends from independent claim 46. Accordingly, the argument set forth above for claim 46 is restated herein in its entirety. In addition, claim 48 includes similar recitations as provided in claims 3 and 23, and thus the arguments provided above for claims 3 and 23 are also repeated herein.

iii. **Claim 52**

Regarding claim 52, this claim depends from independent claim 46. Accordingly, the argument set forth above for claims 46 and 69 is restated herein in its entirety. In addition, claim 52 includes similar recitations as provided in independent claims 1 and 20 (i.e., the reference being non-reflective). Thus, the arguments provided above for independent claims 1 and 20 are also repeated herein.

iv. **Claim 59**

Regarding claim 59, this claim depends from independent claim 46. Accordingly, the argument set forth above for claim 46 is restated herein in its entirety. In addition, claim 59 includes similar recitations as provided in claim 35, and thus the arguments provided above for claim 35 are also repeated herein.

v. **Claim 62**

Regarding claim 62, this claim depends from independent claim 46. Accordingly, the argument set forth above for claim 46 is restated herein in its entirety. In addition, claim 62 includes similar recitations as provided in claim 38, and thus the arguments provided above for claim 38 are also repeated herein.

vi. **Claim 68**

Regarding claim 68, this claim depends from independent claim 46. Accordingly, the argument set forth above for claim 46 is restated herein in its entirety. In addition, claim 68 includes similar recitations as provided in claim 44, and thus the arguments provided above for claim 44 is also repeated herein.

vii. **Summary**

Accordingly, Applicant respectfully requests a confirmation that claims 46-69 fully comply with PCT Articles 33(2) and 33(3).

D. **CLAIMS 71-79**

In the Opinion, the international Examiner alleged that claims 71-79 are rendered obvious by D1, taken alone or in combination with U.S. Patent No. 4,601,036 ("D6"), U.S. Patent No. 4,868,834 ("D7") and European Patent Application No. 0 251 062 ("D8")

Applicant respectfully submits that the alleged combination of D1 and D6-D8 fails to teach, suggest or disclose that at least one of the first and/or second electro-magnetic radiations (provided to the sample and the reference, respectively) **has a spectrum whose mean frequency changes substantially continuously over time at <u>a tuning speed that is greater than 100 Tera Hertz per millisecond</u>**, as explicitly recited in independent claims 71 and 79. Indeed, none of D1, D6, D7 or D8 even mention, much less teach, suggest or disclose that the frequencies of the electro-magnetic radiations being provided to the sample and the reference vary over time, much less that *the tuning speed is greater than 100 Tera Hertz per millisecond*. The international Examiner does not point to any section of other references to teach or suggest such subject matter, and thus apparently agrees that such references fail to cure these deficiencies.

Claims 72-78 depend from independent claim 71. Accordingly, the arguments provided herein above with reference to independent claims71 and 79 are repeated herein for claims 72-78.

Accordingly, Applicant respectfully requests a confirmation that claims 71-79 fully comply with PCT Articles 33(2) and 33(3).

E. CLAIMS 81-93

In the Opinion, the international Examiner alleged that claims 81-93 are rendered obvious by D1, taken alone or in combination with D3 and U.S. Patent Application No. 2003/023153 ("D9").

As an initial matter, Applicant respectfully submits that the alleged combination of D1, D3 and D9 fail to teach, suggest or disclose "**at least one third arrangement for *<u>shifting the frequency</u>* of at least one of the first electro-magnetic radiation (obtained from the sample) and the second electromagnetic radiation (obtained from the reference),**" as explicitly recited in independent claims 81, 92 and 93. Indeed, D1 does not even mention much less teach, suggest or disclose any arrangement which is capable of *shifting the frequency of the electro-magnetic radiations that are associated with the radiation obtained from the sample and/or reference.* It is further asserted that D3 and D9 do not cure at least this deficiency of D1. No other reference relied on by the international Examiner in the Opinion cures such deficiency of D1.

In addition, for the same reasons as set forth herein above for independent claims 46 and 69, Applicant respectfully asserts that D3 is not combinable with D1 in a manner contemplated by the Examiner to teach or suggest Applicant's invention as recited in independent claims 81, 92 and 93. This is at least because the use of the system described in D3 would not work in conjunction with the systems described in D1. In fact, the alleged combination of the teachings of D1 and D3 would produce a system that could not be operable.

Accordingly, independent claims 81, 92 and 93, and claims 82-90 which depend therefrom are not taught, suggested or disclosed by the alleged combination of

D1, D3 and D9. Therefore, Applicant respectfully requests a confirmation that claims 81-93 fully comply with PCT Articles 33(2) and 33(3).

III. NEW CLAIMS 94 AND 95

New claims 94 and 95 are provided herein to further define various aspects of the present invention. Support for these claims can be found throughout the specification, drawings and originally-filed claims. (See, e.g., Applicant's specification, p. 27, lns. 25-28). In particular, new independent claims 94 and 95 recite that at least one of the first and/or second electro-magnetic radiations has a spectrum whose mean frequency changes substantially continuously over time at a repetition rate of approximately 15.7 KHertz. Applicant respectfully asserts that none of the publications relied on by the Examiner in the Opinion teaches, suggests or discloses such claimed subject matter. At least for this reason, Applicant respectfully asserts that these claims comply with PCT Article 33(2)-(4).

IV. CONCLUSION

In view of the foregoing, the international Examiner's Opinion concerning the lack of novelty in claims 1-6, 15, 18, 20-33, 45, 45 and 80 and the lack of inventive step in claims 1-18, 19 (in part), 20-70, 71-79 (in part) and 80-93 in the present international application is respectfully traversed. In addition, Applicant respectfully request the confirmation that new claims 94 and 95 fully comply with PCT Article 33(2)-(4). In summary, it is respectfully submitted that all pending claims 1-95, as presently presented, meet the requirements of PCT Articles 33(2)-(4). In view of the foregoing amendments, new claims and remarks, a favorable written opinion is respectfully solicited.

In the event that any fees are due in connection with this filing, the Commissioner is hereby authorized to charge such fees to EP deposit account no. 28300716.

Respectfully submitted,

Dated: August 23, 2005

Gary Abelev
U.S.P.T.O. Reg. No. 40,479

Attorney for Applicant
DORSEY & WHITNEY L.L.P.
250 Park Avenue
New York, New York 10177
(212) 415-9371

Enclosure (Supplemental Sheets – Amended Claims and New Claims)

4813-6406-3232\1

CLAIMS

1. An apparatus comprising:

at least one first arrangement providing at least one first electro-magnetic radiation to a sample and at least one second electro-magnetic radiation to a non-reflective reference, wherein a frequency of radiation provided by the at least one first arrangement varies over time; and

at least one second arrangement detecting an interference between at least one third radiation associated with the at least one first radiation and at least one fourth radiation associated with the at least one second radiation.

2. The apparatus according to claim 1, wherein the at least one third radiation is a radiation returned from the sample, and the at least one fourth radiation is a radiation returned from the reference.

3. The apparatus according to claim 1, further comprising at least one third arrangement for shifting the frequency of at least one of the at least one first electro-magnetic radiation, the at least one second electromagnetic radiation, the at least one third electro-magnetic radiation or the at least one fourth electro-magnetic radiation.

4. The apparatus according to claim 1, further comprising at least one third arrangement generating an image based on the detected interference.

5. The apparatus according to claim 4, further comprising a probe which scans a transverse location of the sample to generate scanning data, and which provides the scanning data to the third arrangement so as to generate the image.

6. The apparatus according to claim 5, wherein the scanning data includes the detected interference obtained at multiple transverse locations on the sample.

7. The apparatus according to claim 1, wherein at least one second arrangement comprises at least one photodetector and at least one electrical filter which follows the at least one photodetector.

8. The apparatus according to claim 3, wherein at least one second arrangement comprises at least one photodetector and at least one electrical filter which follows the at least one photodetector.

9. The apparatus according to claim 8, wherein the at least one electric filter is a bandpass filter having a center frequency that is approximately the same as a magnitude of the frequency shift by the frequency shifting arrangement.

10. The apparatus according to claim 9, wherein a transmission profile of the electrical filter varies substantially over its passband.

11. The apparatus according to claim 5, wherein the probe comprises a rotary junction and a fiber-optic catheter.

12. The apparatus according to claim 11, wherein the catheter is rotated at a speed higher than 30 revolutions per second.

13. The apparatus according to claim 1, further comprising at least one polarization modulator.

14. The apparatus according to claim 1, wherein the at least one second arrangement is capable of detecting a polarization state of at least one of the first and second electromagnetic radiation.

15. The apparatus according to claim 1, wherein the at least one second arrangement comprises at least one dual balanced receiver.

16. The apparatus according to claim 1, wherein the at least one second arrangement comprises at least one polarization diverse receiver.

17. The apparatus according to claim 1, wherein the at least one second arrangement comprises at least one polarization diverse and dual balanced receiver.

18. The apparatus according to claim 1, further comprising at least one third arrangement for tracking the phase difference between at least one of:

- the at least one first electromagnetic radiation and the at least one second electromagnetic radiation, and
- the at least one third electromagnetic radiation and the at least one fourth electromagnetic radiation.

19. The apparatus according to claim 1, further comprising an arrangement emitting a particular radiation which is provided to the at least one first arrangement when the at least one first arrangement provides the first and second electro-magnetic radiations based on the particular radiation, wherein at least one of the first and second electro-magnetic radiations has a spectrum whose mean frequency changes substantially continuously over time at a tuning speed that is greater than 100 Tera Hertz per millisecond.

20. A method comprising the steps of:

providing at least one first electro-magnetic radiation to a sample and at least one second electro-magnetic radiation to a non-reflective reference, wherein a frequency of the at least one of the first and second radiations varies over time; and

detecting an interference between at least one third radiation associated with the at least one first radiation and at least one fourth radiation associated with the at least one second radiation.

21. An apparatus comprising:

at least one first arrangement providing at least one first electro-magnetic radiation to a sample and at least one second electro-magnetic radiation to a reference, wherein at least one of the first and second electro-magnetic radiations has a spectrum which changes over time, the spectrum containing multiple differing longitudinal modes; and

at least one second arrangement detecting an interference between at least one third radiation associated with the at least one first radiation and at least one fourth radiation associated with the at least one second radiation.

22. The apparatus according to claim 21, wherein the at least one third radiation is a radiation returned from the sample, and the at least one fourth radiation is a radiation returned from the reference.

23. The apparatus according to claim 21, further comprising at least one third arrangement for shifting the frequencies of at least one of the at least one first electro-magnetic radiation, the at least one second electromagnetic radiation, the at least one third electro-magnetic radiation and the at least one fourth electromagnetic radiation.

24. The apparatus according to claim 21, further comprising at least one third arrangement generating an image based on the detected interference.

25. The apparatus according to claim 24, further comprising a probe which scans a transverse location of the sample to generate scanning data, and which provides the scanning data to the third arrangement so as to generate the image.

26. The apparatus according to claim 25, wherein the scanning data includes the detected interference obtained at multiple transverse locations on the sample.

27. The apparatus according to claim 21, wherein the reference is non-reflective.

28. The apparatus according to claim 21, wherein a median of the spectrum varies substantially linearly over time.

29. The apparatus according to claim 28, wherein a rate of change of the median of the spectrum is at least 1000nm/msec.

30. The apparatus according to claim 21, wherein the spectrum change over time repetitively with a repetition rate of at least 10 kHz.

31. The apparatus according to claim 21, wherein the at least one first arrangement includes a spectral filter to vary the spectrum over time.

32. The apparatus according to claim 31, wherein the spectral filter includes a polygon scanner and a spectral separating arrangement that vary the spectrum over time.

33. The apparatus according to claim 21, wherein the at least one first arrangement includes a semiconductor gain medium at least one of generating and amplifying an electro-magnetic radiation.

34. The apparatus according to claim 23, wherein at least one second arrangement comprises at least one photodetector and at least one electrical filter which follows the at least one photodetector.

35. The apparatus according to claim 34, wherein the at least one electric filter is a bandpass filter having a center frequency that is approximately the same as a magnitude of the frequency shift by the frequency shifting arrangement.

36. The apparatus according to claim 35, wherein a transmission profile of the electrical filter varies substantially over its passband.

37. The apparatus according to claim 25, wherein the probe comprises a rotary junction and a fiber-optic catheter.

38. The apparatus according to claim 37, wherein the catheter is rotated at a speed higher than 30 revolutions per second.

39. The apparatus according to claim 21, further comprising at least one polarization modulator.

40. The apparatus according to claim 21, wherein the at least one second arrangement is capable of detecting a polarization state of at least one of the first and second electromagnetic radiation.

41. The apparatus according to claim 21, wherein the at least one second arrangement comprises at least one dual balanced receiver.

42. The apparatus according to claim 21, wherein the at least one second arrangement comprises at least one polarization diverse receiver.

43. The apparatus according to claim 21, wherein the at least one second arrangement comprises at least one polarization diverse and dual balanced receiver.

44. The apparatus according to claim 21, further comprising at least one third arrangement for tracking the phase difference between at least one of:

- the at least one first electromagnetic radiation and the at least one second electromagnetic radiation, and
- the at least one third electromagnetic radiation and the at least one fourth electromagnetic radiation.

45. A method comprising the steps of:

providing at least one first electro-magnetic radiation to a sample and at least one second electro-magnetic radiation to a reference, wherein at least one of the first and second electro-magnetic radiation has a spectrum which changes over time, the spectrum containing multiple differing longitudinal modes; and

detecting an interference between at least one third radiation associated with the at least one first radiation and at least one fourth radiation associated with the at least one second radiation.

46. An apparatus comprising:

at least one first arrangement providing at least one first electro-magnetic radiation to a sample and at least one second electro-magnetic radiation to a reference, wherein a frequency of radiation provided by the at least one first arrangement varies over time;

at least one second arrangement detecting a first interference signal between at least one third radiation associated with the at least one first radiation and at least one fourth radiation associated with the at least one second radiation in a first polarization state; and

at least one third arrangement detecting a second interference signal between the third and fourth electro-magnetic radiations in a second polarization state, wherein the first and second polarization states being different from one another.

47. The apparatus according to claim 46, wherein the at least one third radiation is a radiation returned from the sample, and the at least one fourth radiation is a radiation returned from the reference.

48. The apparatus according to claim 46, further comprising at least one fourth arrangement configured to shift the frequency of at least one of the at least one first electro-magnetic radiation, the at least one second electromagnetic radiation, the at least one third electro-magnetic radiation and the at least one fourth electro-magnetic radiation.

49. The apparatus according to claim 46, further comprising at least one fourth arrangement generating an image based on the detected interference.

50. The apparatus according to claim 49, further comprising a probe which scans a transverse location of the sample to generate scanning data, and which provides the scanning data to the fourth arrangement so as to generate the image.

51. The apparatus according to claim 50, wherein the scanning data includes the detected interference obtained at multiple transverse locations on the sample.

52. The apparatus according to claim 46, wherein the reference is non-reflective.

53. The apparatus according to claim 46, wherein a median of the spectrum varies substantially linearly over time.

54. The apparatus according to claim 46, wherein the at least one first arrangement includes a spectral filter to vary the spectrum over time.

55. The apparatus according to claim 54, wherein the spectral filter includes a polygon scanner and a spectral separating arrangement that vary the spectrum over time.

56. The apparatus according to claim 46, wherein the at least one first arrangement includes a semiconductor gain medium at least one of generating and amplifying an electro-magnetic radiation.

57. The apparatus according to claim 46, further comprising at least one fourth arrangement generating an image based on the detected interference, wherein the first and second polarization states are approximately orthogonal to one another.

58. The apparatus according to claim 48, wherein at least one second arrangement comprises at least one photodetector and at least one electrical filter which follows the at least one photodetector.

59. The apparatus according to claim 58, wherein the at least one electric filter is a bandpass filter having a center frequency that is approximately the same as a magnitude of the frequency shift by the frequency shifting arrangement.

60. The apparatus according to claim 59, wherein a transmission profile of the electrical filter varies substantially over its passband.

61. The apparatus according to claim 50, wherein the probe comprises a rotary junction and a fiber-optic catheter.

62. The apparatus according to claim 62, wherein the catheter is rotated at a speed higher than 30 revolutions per second.

63. The apparatus according to claim 46, further comprising at least one polarization modulator.

64. The apparatus according to claim 46, wherein the at least one second arrangement is capable of detecting a polarization state of at least one of the first and second electromagnetic radiation.

65. The apparatus according to claim 46, wherein the at least one second arrangement comprises at least one dual balanced receiver.

66. The apparatus according to claim 46, wherein the at least one second arrangement comprises at least one polarization diverse receiver.

67. The apparatus according to claim 46, wherein the at least one second arrangement comprises at least one polarization diverse and dual balanced receiver.

68. The apparatus according to claim 46, further comprising at least one third arrangement for tracking the phase difference between at least one of:

- the at least one first electromagnetic radiation and the at least one second electromagnetic radiation, and
- the at least one third electromagnetic radiation and the at least one fourth electromagnetic radiation.

69. A method comprising the steps of:

providing at least one first electro-magnetic radiation to a sample and at least one second electro-magnetic radiation to a reference, wherein a frequency of the at least one of the first and second radiations varies over time;

detecting a first interference signal between at least one third radiation associated with the at least one first radiation and at least one fourth radiation associated with the at least one second radiation in a first polarization state; and

detecting a second interference signal between the third and fourth electro-magnetic radiations in a second polarization state, wherein the first and second polarization states being different from one another.

70. The method according to claim 69, wherein the at least one third radiation is a radiation returned from the sample, and the at least one fourth radiation is a radiation returned from the reference.

71. An apparatus comprising:

at least one first arrangement providing at least one first electro-magnetic radiation to a sample and at least one second electro-magnetic radiation to a reference, wherein at least one of the first and second electro-magnetic radiations has a spectrum whose mean frequency changes substantially continuously over time at a tuning speed that is greater than 100 Tera Hertz per millisecond; and

at least one second arrangement detecting an interference between at least one third radiation associated with the at least one first radiation and at least one fourth radiation associated with the at least one second radiation.

72. The apparatus according to claim 71, wherein the mean frequency changes repeatedly at a repetition rate that is greater than 5 kilo Hertz.

73. The apparatus according to claim 71, wherein the mean frequency changes over a range that is greater than 10 Tera Hertz.

74. The apparatus according to claim 71, wherein the spectrum has an instantaneous line width that is smaller than 100 Giga Hertz.

75. The apparatus according to claim 71, further comprising a laser cavity with a roundtrip length shorter than 5 m.

76. The apparatus according to claim 73, the center of the tuning range of the spectrum is nominally centered at 1300 nm.

77. The apparatus according to claim 73, the center of the tuning range of the spectrum is nominally centered at 850 nm.

78. The apparatus according to claim 73, the center of the tuning range of the spectrum is nominally centered at 1700 nm.

79. A method comprising the steps of:

providing at least one first electro-magnetic radiation to a sample and at least one second electro-magnetic radiation to a reference, wherein at least one of the first and second electro-magnetic radiations has a spectrum whose mean frequency

changes substantially continuously over time at a tuning speed that is greater than 100 Tera Hertz per millisecond; and

detecting an interference between at least one third radiation associated with the at least one first radiation and at least one fourth radiation associated with the at least one second radiation.

80. An apparatus comprising:

at least one first arrangement providing at least one first electro-magnetic radiation to a sample and at least one second electro-magnetic radiation to a reference, wherein a frequency of radiation provided by the at least one first arrangement varies over time;

at least one second arrangement adapted for shifting the frequency of the at least one first electro-magnetic radiation and the at least one second electromagnetic radiation;

an interferometer interfering the first and second electro-magnetic radiations to produce an interference signal; and

at least one second arrangement detecting the interference between the first and second electro-magnetic radiations.

81. A system for determining particular data associated with at least one of a structure and composition of a tissue, comprising:

a processing arrangement, which when executing a predetermined technique, is configured to:

a) receive information associated with an interferometric signal which is formed from at least one first electro-magnetic radiation obtained from a sample and at least one second electro-magnetic radiation obtained from a reference, wherein at least one of the first and second electro-magnetic radiations is frequency-shifted,
b) sample the information to generate sampled data in a first format, and
c) transform the sampled data into the particular data that is in a second format, the first and second format being different from one another.

82. The system according to claim 81, wherein the second format has at least two sampling intervals representing substantially the same electro-magnetic frequency difference.

83. The system according to claim 82, wherein each of the sampling intervals represents substantially the same electro-magnetic frequency difference.

84. The system according to claim 81, wherein procedure (c) includes interpolating the sampled data.

85. The systems according to claim 84, wherein at least one of the first and second electro-magnetic radiations is frequency-shifted by a particular frequency, and wherein the interpolation includes Fourier transforming the sampled data into an array in a frequency domain and separating the array into at least two frequency bands based on the particular frequency.

86. The system according to claim 85, wherein the interpolation includes Fourier transforming the sampled data into an array in a frequency domain, and increasing a size of the array and inserting a predetermined value into each element of an increased portion of the array.

87. The system according to claim 81, wherein the processing arrangement is further configured to generate an image of at least one portion of the tissue based on the particular data.

88. The system according to claim 87, wherein the image has a particular resolution, wherein a spectrum of electro-magnetic frequencies associated with the sampled data relates to the particular resolution, and wherein the particular resolution is substantially proximal to a Fourier Transform limit of the spectrum of the electro-magnetic frequencies.

89. The system according to claim 85, wherein the second format has at least two sampling intervals representing substantially the same electro-magnetic frequency

difference, and wherein a magnitude of the particular frequency is greater than approximately a quarter of a reciprocal of at least one of the sampling intervals.

90. The system according to claim 87, wherein the second format is an image format, and wherein the image is based on the transformed sampled data.

91. The system according to claim 84, wherein the second format is a format that includes approximately constant k-space intervals.

92. A method for determining particular data associated with at least one of a structure and composition of a tissue, comprising the steps:

receiving information associated with an interferometric signal which is formed from at least one first electro-magnetic radiation obtained from a sample and at least one second electro-magnetic radiation obtained from a reference, wherein at least one of the first and second electro-magnetic radiations is frequency-shifted;

sampling the information to generate sampled data in a first format; and

transforming the sampled data into the particular data that is in a second format, the first and second format being different from one another.

93. Storage medium for determining particular data associated with at least one of a structure and composition of a tissue, the storage medium maintaining a program thereon which, when executed by a processing arrangement is configured to perform instructions comprising::

receiving information associated with an interferometric signal which is formed from at least one first electro-magnetic radiation obtained from a sample and at least one second electro-magnetic radiation obtained from a reference, wherein at least one of the first and second electro-magnetic radiations is frequency-shifted;

sampling the information to generate sampled data in a first format; and

transforming the sampled data into the particular data that is in a second format, the first and second format being different from one another.

94. An apparatus comprising:

at least one first arrangement providing at least one first electro-magnetic radiation to a sample and at least one second electro-magnetic radiation to a reference,

wherein at least one of the first and second electro-magnetic radiations has a spectrum whose mean frequency changes substantially continuously at a repetition rate of approximately 15.7 KHertz; and

at least one second arrangement detecting an interference between at least one third radiation associated with the at least one first radiation and at least one fourth radiation associated with the at least one second radiation.

95. A method comprising the steps of:

providing at least one first electro-magnetic radiation to a sample and at least one second electro-magnetic radiation to a reference, wherein at least one of the first and second electro-magnetic radiations has a spectrum whose mean frequency changes substantially continuously over time at a repetition rate of approximately 15.7 KHertz; and

detecting an interference between at least one third radiation associated with the at least one first radiation and at least one fourth radiation associated with the at least one second radiation.